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AUTHOR Harwell, Sharon H.; Enger, Sandra K.
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ABSTRACT

Followup sessions were conducted for Alabama teachers who completed training in the "Exploring Space: The Classroom Connection" science teaching program in summer 1997. The effectiveness of these sessions was evaluated for 71 teachers. This analysis also allowed for a comparison of several basic concepts about science of the 1996 Alabama teachers with those teachers in the 1998 followup sessions. Most of the teachers taught prekindergarten through grade 5, but those teaching grades 6 through 8 were the second largest group. Most of the teachers were white, and most taught in predominantly rural settings. Findings indicate that, while teachers expressed agreement with the philosophy and basic premises of constructivism and process-based science instruction, they often appeared to have a confused understanding of the philosophy of constructivism. Teacher responses suggest that some of their actions are supportive of good science learning but that there are areas to target in order to increase science learning opportunities. Teacher responses also indicate that most science classrooms were teacher-driven rather than learner-centered. There were no significant differences between the 1996 followup group of teachers and those from 1998 for science concepts except for the Nature of Science domain. Teachers indicated an overall high degree of satisfaction with the followup sessions. Sharing sessions also demonstrated that teachers need collegial support and encouragement from other program participants to stay motivated throughout the year. Evaluation findings support the effectiveness of the program. Implications for future research into program effectiveness through student data are discussed. (Contains 18 tables and 14 references.) (SLD)

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Exploring Space: An Evaluative Portrait of Alabama Teachers

By

Dr. Sharon H. Harwell
Assistant Professor of Education

and

Dr. Sandra K. Enger
Assistant Professor of Education
and
Coordinator of Science Education
Institute for Science Education

The University of Alabama in Huntsville
Huntsville, AL

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Enger, Sandra

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EXECUTIVE SUMMARY

OVERVIEW

This evaluation of follow-up sessions conducted for Alabama teachers who completed training in the summer 1997 program, *Exploring Space: The Classroom Connection*, examines the effectiveness of follow-up sessions for 71 teachers and provides a comparison of several basic concepts about science of the 1996 Alabama teachers with those teachers in the 1998 follow-up sessions. Baseline data regarding teachers' perceptions of their science classrooms, teachers' perceptions of classroom science inquiry opportunities for students, and teachers' perceptions of who makes decisions about science lessons and activities (students or teachers) is presented. Demographic data, science teaching efficacy beliefs, and program "satisfaction" are also presented.

Conclusions about the 1997 summer program, *Exploring Space: The Classroom Connection*, reached through collaboration of the evaluation team and the program development team provided the impetus for initiation of the follow-up mini-conferences targeted toward Alabama teachers in three areas of the state: Huntsville, Birmingham, and Montgomery. Informal observations about the summer 1997 training and teacher needs assessments instructed the evaluation team and project personnel in development of session topics. These observations included:

> The summer program training increased teachers' understanding and awareness of inquiry science and basic conceptual understanding of science; however, informal observations of teachers during the summer sessions showed that teachers struggled with integration of computer technologies into their curriculum, especially use of the internet as a tool for inquiry.
>
> Convenience interviews with teachers during the summer sessions and evaluation during the debriefing sessions demonstrated that teachers desired more knowledge related to math in space and applications of that knowledge in their classrooms.
>
> Teachers consistently requested time for sharing of ideas about how other teachers were implementing space science activities into their curriculum.
>
> Teachers who participated in the 1996 *Space Orientation for Professional Educators* follow-up sessions felt that the November dates for follow-up sessions were too early because teachers had not had enough time to implement learning from the summer program.

Subsequently, program personnel used this information as the basis for determination of instructional needs and schedules for the 1998 follow-up sessions.

EVALUATION PROCEDURES

In evaluating the professional development component of the mini-conference sessions, the evaluation team administered a survey to teachers before sessions began. Teachers provided demographic information and communicated their current understanding of basic science concepts and their perceptions of their science classroom learning environment. Teachers also communicated their level of satisfaction with the use of content presented and delivery of that content.

SPECIFIC FINDINGS

Findings in this section are divided into the following categories: teacher background, basic concepts of science, teachers' perceptions of classroom science inquiry

opportunities, perceptions of science classroom , perceptions of who makes decisions about science lessons, and satisfaction with *Exploring Space: The Classroom Connection* follow-up sessions.

Teacher Background

The majority of the Alabama teachers attending the follow-up sessions were Pre-kindergarten through Elementary Level Grade 5, while the Middle Level Grades 6-8 comprised the second largest group. As might be expected, most of these teachers taught all subject areas and demonstrated a wide variance in experience in general teaching and in teaching math and science. Of special note is the finding that over 58 percent of these teachers possessed a Masters Degree and/or a Masters Degree plus additional coursework. This fact which when coupled with the finding that these teachers as a group scored high on the personal teaching efficacy belief component of the *Science Teaching Efficacy Belief Inventory* indicates this group of Alabama teachers were highly motivated teachers. Of special note is the finding that only four percent of this group of teachers were African-American while 90 percent were Caucasian. This fact raises a question regarding equity in participation in follow-up professional development opportunities for underrepresented teachers and should be explored.

Most teachers taught in public schools in a predominately rural setting with student enrollments in excess of 500 students. Student populations were very diverse. The largest percentage estimate of minority students was fewer than 25 percent while teachers estimated between 26-50 percent of female students in their classrooms. Most teachers reported a positive experience with teaching science. Teachers did not perceive themselves as well prepared to use the inquiry approach to teaching science. Although teachers reported textbooks were not an important part of their science program, this should not be considered a negative, but an important move in the direction of use of the inquiry approach and the constructivist epistemology.

Basic Concepts of Science

This portion of the evaluation examined teacher knowledge of basic concepts inherent in inquiry-based science intended to facilitate development of problem-solving skills, independent thinking, and learning. All items measured were indicative of the constructivist epistemology and instructional strategies and assessments supportive of that approach. Baseline data for Alabama teachers in the 1996 follow-up sessions provided a comparison group for teachers in the 1998 follow-up sessions. The statistical *t* test of analysis for significant differences between the two groups of teachers was calculated.

Teachers expressed overall agreement with the philosophy and basic premises of constructivism and process-based science instruction. However, the overall low average concept mean in the Constructivist Approach domain indicated teachers possessed a confused understanding of the philosophy of constructivism. Teachers brought varying levels of prior knowledge regarding the Development of Concepts even though most teachers expressed agreement with items in this category. There was a moderately high agreement with items comprising the Inquiry in Science component with low variance among teachers. Teachers showed mixed levels of knowledge and understanding about the Nature of Science while this same group of teachers showed a moderate level of prior knowledge and understanding about Interdisciplinary Connections and Assessments. As a group, teachers were aware of the new standards in science, but possessed a low level of prior knowledge about items measuring this component.

When the *t* test for independent samples was calculated for the overall concept mean for each component of this measure of science concepts, it was discovered that there were no significant differences between the 1996 follow-up teachers and those teachers in the 1998 follow-up group in all categories except the Nature of Science domain. The calculated *t* value of 2.26 was found to be significant at the .05 level of significance with 240 *degrees of*

freedom. In looking at individual items within this category, the item "When teaching about microgravity, a good way to explain the concept is to say it is "weightlessness." showed the greatest difference in mean scores and may be the reason for this significant difference. A look at program emphases for the two summer programs might provide clues helpful in explaining this difference.

Teachers' Perceptions of Classroom Science Inquiry Opportunities for Students

These Alabama teachers' responses suggest that some of their actions are supportive of good science learning and responses also indicate that there are areas to target in order to increase science learning opportunities. A high frequency of Alabama teachers reported "On-going Classroom Experience" in the following science inquiry activities: using scientific inquiry; interpreting data from graphs; making predictions; making observations; drawing inferences; using problem-solving strategies; using critical thinking; doing hands-on activities and experiments; and communicating results of their investigations to peers. Responses on several items suggested that many teachers were providing experiences in science inquiry within the context of some of the lessons planned for students.

A noticeable percentage (10% and above) of Alabama teachers reported they provided "No experience at all" in controlling variables, using laboratory equipment, analyzing science materials for validity of the information, designing and conducting their own activities and experiments, doing additional experiments if discrepancies exist between answers and explanations, keeping a laboratory log or journal, and reading and discussing the work of scientists. Follow-up interviews and classroom observation would provide a better understanding of these teachers' responses.

Teacher Perceptions of Their Science Classroom

Generally, as a group these Alabama teachers report that students often work in groups or teams, and especially so when doing science activities, making predictions about what will happen before they do activities or experiments, making observations when they do activities, writing down their observations from an experiments, and if activities or experiments do not appear to work as predicted, they discuss reasons why. On the other hand, results indicate that students seldom work alone when doing science activities and seldom design their own experiments or try experiments that they design themselves. These teachers also reported that students seldom set up their own experiments and seldom read about the research work that scientists do and seldom go on field trips off-campus that relate to what they do in science class. As a rule, mean responses for this group of Alabama teachers indicated that students sometimes engaged in the selected science activities included in this survey. Systematic classroom observation and measurement of student perceptions of their classroom learning environment would provide a more accurate picture of Alabama teachers' science learning environments.

Teacher Perceptions of Who Makes Decisions About Science Lessons and Activities

As a rule, these Alabama teachers decide what the science lessons are about and also teachers decide what science activities and experiments students do. This finding corresponds to teachers' responses concerning their perceptions that students seldom set up experiments and seldom design their own experiments or try experiments on their own. This finding clearly points to a teacher-driven classroom learning environment when contrasted to a learner-centered philosophy.

Satisfaction with Follow-up Sessions

Alabama teachers indicated an overall high satisfaction level with all aspects of the follow-up sessions. Trainer-related ratings were generally higher than application of ideas and teacher confidence to implement instruction reflective of content provided. Teachers' written responses indicated teachers generally were very pleased with all the sessions and

activities they engaged in during sessions and with presenters' enthusiasm, preparation, knowledge, and willingness to accept participants' ideas, questions, and comments. Several worthwhile suggestions from earlier sessions were incorporated into subsequent follow-up sessions. Teachers indicated great satisfaction with resources provided related to new developments in space science and most teachers wanted "more" resources. Of special note is the success of the "Sharing Time" which was added to the 1998 follow-up sessions. Teachers' responses were positive and teachers were "motivated" for "another year" as they returned to their classrooms.

IMPLICATIONS AND CHALLENGES

The 1998 follow-up sessions for Alabama teachers participating in *Exploring Space: The Classroom Connection* have successfully demonstrated the need to provide additional instruction and support activities for Alabama teachers as they integrate space science activities into their classroom curriculum. This extended program proved very effective and teachers expressed great satisfaction with all aspects of the program. The ability and flexibility of the program development team to respond to the evolving needs of teachers is most commendable. The initiation of a systematic approach to monitoring the attitudes, knowledge, and understanding of science concepts proved very beneficial to project personnel in determining differences between groups of Alabama teachers and in planning subsequent programs targeted at meeting the identified needs of teachers in future program plans. With the addition of new measures to explore teachers' perceptions of their science classroom and teachers' perceptions of opportunities for student engagement in science inquiry within their classroom proved beneficial in identification of challenges for future research and practice associated with future *Exploring Space: The Classroom Connection* summer programs and possible follow-up sessions. These challenges include:

1. Do Alabama teachers who participated in the summer program maintain and refine their practice of inquiry science and use of exemplary instructional strategies for science during the academic year when they return to their schools where minimal support is all they receive? The sharing sessions indicated teachers needed that collegial support and encouragement from other program participants to stay motivated throughout the year.

2. To what extent do students perceive their classrooms as being supportive of exemplary science teaching practices? Teachers generally perceive their practice as being supportive of inquiry science; however, there is no student data to substantiate teacher perceptions.

3. What types of systemic conditions would support teacher philosophical change from a teacher-driven classroom learning environment to a more learner-centered learning environment promoting autonomy, independence, responsibility, and ownership of learning?

4. To what degree can future *Exploring Space: The Classroom Connection* programs assist teachers in constructing a more inclusive understanding of the nature of science?

5. To what extent can future programs insure equitable opportunities for participation of groups underrepresented in *Exploring Space: The Classroom Connection*?

6. To what extent are program goals, content, and instructional strategies aligned with national and state standards for math and science? An initial effort was made in the summer 1997 program to address the science inquiry and professional development standards. However, efforts should be expanded in this direction.

SECTION I. INTRODUCTION AND BACKGROUND

The professional development program, *Exploring Space: The Classroom Connection,* in Hunstville, AL is the first of three levels of programs within a larger project funded in part by two federal grants under the Title II Dwight D. Eisenhower Professional Development Program administered by the Alabama Commission on Higher Education (ACHE) and the Title VI Innovative Strategies Program administered by the Alabama State Department of Education. Level II, *Exploring Space: The Capital Connection* in Washington, DC and Level III, *Exploring Space: The Russian Connection,* are two additional program levels available for professional educators. Level I, *Exploring Space: The Classroom Connection* is a graduate level three-semester-hour course offered by the University of Alabama in Huntsville (UAH), in conjunction with the U. S. Space and Rocket Center, NASA's Marshall Space Flight Center and various aerospace firms. The course is designed to assist classroom educators in development and improvement of science, mathematics, and social studies curricula in our nation's elementary and secondary schools.

The *Classroom Connection* introduces elementary and secondary teachers and supervisors to a wide variety of space-related subjects including a first-hand look at state-of-the-art technology. Participants learn principles of space science and technology from leading experts in the corporate, NASA, and university communities. Participants engage in a hands-on experience through the assistance of UAH faculty on the cutting edge of space science research and engineering, NASA's Marshall Space Flight Center experts working on other dimensions of the U. S. space effort, such as the International Space Station and the Hubble Space Telescope. Participants engage in activities directed by NASA's official Visitor Information Center (the world's largest non-profit space education facility and home to SPACE CAMP). Teachers train in Space Shuttle simulators and professional astronaut training devices in preparation for a two-hour simulated Space Shuttle mission.

TEACHER TRAINING

This program, *Exploring Space: The Classroom Connection,* provided approximately 45 hours of intensive classroom, laboratory, and training time. A detailed description of the workshops, specific program activities, mission related activities, briefings, and additional opportunities included in the 1997 Summer Institute can be found in the final report (Harwell, 1998). Personnel, schedules, and specific course requirements are also included. Alabama teachers involved in this program were asked to participate in the February 1998 follow-up mini-conferences.

SECTION II. TEACHER EVALUATION

An integral component of the *Classroom Connection* program revolved around the continuous formative and summative evaluation of each of the six (6) training sessions. Members of the evaluation team attended each *Classroom Connection* team's debriefing session and wrote a formative evaluation which was used to inform program changes and make adjustments in following sessions. Summer 1997 *Exploring Space: The Classroom Connection* teachers also completed a quantitative assessment which provided demographic information, science concept understanding, and science teaching efficacy beliefs. Observations from the summer 1997 program were completed and directors found evaluations useful in planning the next year's program. These suggestions were also used by project personnel to inform decision making regarding follow-up continuing education topics for Alabama teachers. Program evaluation followed the responsive model first advocated by Stake (Worthen et al., 1997; Denzin & Lincoln, 1998). The central focus of this model resides in addressing the "concerns and issues of a stakeholder audience" in an effort to "improve and focus" directly upon program activities rather than program interests (Worthen et al., 1997, p. 159). The program evaluation design, implementation, and report writing were based upon standard program evaluation techniques (Joint Committee on Standards for Educational Evaluation, 1994).

Alabama Teacher Follow-up Evaluation

The *Exploring Space: The Classroom Connection* professional development team decided to use the same assessment instruments used in the pilot evaluation for Alabama teachers in academic year 1996-97 (Harwell, 1997). This measure provided baseline data for comparison and long-term evaluation. Two assessment items were added: The *Science Teaching Efficacy Belief Inventory (STEBI)* developed by Enoch and Riggs (Enoch & Riggs, 1990; Riggs & Enoch, 1990) and several survey items related to teacher perceptions of their science classrooms and teacher perceived classroom opportunities for students to practice science inquiry developed by Dr. Sandra Enger in the Institute for Science Education (Enger, 1997a; 1997b).

Evaluation data collected during debriefing sessions conducted at the conclusion of each session of the Summer 1997 Institutes directed program personnel in identification of several themes teachers expressed weaknesses and/or a need for additional information. Based upon the November 1996 follow-up evaluations, it was decided to move the sessions from a November time schedule to a February date because most teachers have not had time to incorporate and/or integrate summer institute learning into their classroom curriculum. Project personnel used this rationale to schedule follow-up sessions in Huntsville on February 6, Birmingham on February 13, and Montgomery on February 20, 1998 (Harwell, 1998; 1997).

Mini-conference sessions included the following: Concurrent sessions on "Math in Space" and "The Internet and Your Curriculum" in the morning and afternoon; "Space News," "Sharing," and "Evaluation and General Discussion." All teachers attending each mini-conference site participated in the "Sharing," "Space News," and "Evaluation and General Discussion" sessions as a total group. Teachers divided into two groups and rotated through two options: "Math in Space," and "The Internet and Your Curriculum."

Evaluation Procedures

Each teacher received an evaluation packet as she/he entered the conference room for the Registration/Orientation session. Teachers completed all assessment instruments with the exception of the "satisfaction" scale, as they enjoyed sweet rolls, juice, and coffee. Each teacher's evaluation packet was assigned an identification number and every effort was made to achieve anonymity.

***Exploring Space: The Classroom Connection* Evaluation Forms**

Evaluation Form 1: The first section of this evaluation consisted of items related to teachers' academic and professional background and their prior experience and attitude toward science. The second section captured teachers' attitudes toward the philosophy and assumptions underlying appropriate science teaching pedagogy (five statements). The remaining six sections included 25 items with each set of four (one section consisted of five items) representative of the main objectives of the mini-conference sessions. Some items were adapted from the Montgomery County Public Schools NSF project in Maryland (Saab, R. & Larson, J., *Evaluation of Teacher Training and Classroom Implementation*, 1996). Verbal approval to use selected items with adaptation was obtained from Mr. John Larson after completion of a workshop under his leadership at the National Evaluation Conference held in Bethesda, MD in July 1996. Other items were developed after extensive collaboration with project staff. All items are consistent with exemplary science teaching practices and are aligned with the national science education standards (National Research Council, 1996). Since thirteen of the 30 items in this form were constructed as negative items, that is, a 'strongly disagree' response reflects a 'correct' response, and a 'strongly agree' response reflects an 'incorrect' response, these items were reverse coded. The data that appears in the tables is now uni-directional for all items: '4' and '3' represent correct responses, and '1' and '2' represent incorrect responses even though the actual items in the table displaying

data continue to be phrased negatively as they appear on the evaluation form completed by teachers.

Evaluation Form 2: This section consisted of 30 survey items intended to elicit teachers' perceptions of the frequency of student engagement in exemplary practices in their science classroom learning environments. Four items tapped teachers' perceptions of who makes decisions about science lessons and activities. Finally, this section measured teachers' perceptions of science class opportunities students have that provide experience in science inquiry. Survey items were initially developed by Dr. Sandra K. Enger in the UAH Institute for Science Education and were adapted and used with permission in this study (Enger, 1997a; 1997b).

Evaluation Form 3: The *Science Teaching Efficacy Belief Inventory (STEBI)* developed by Drs. Larry Enoch and Iris Riggs was used to measure teachers' beliefs in their ability to perform behaviors needed to facilitate effective science learning in their students. This well-validated instrument allowed measurement of two dimensions of science teaching efficacy: Personal Teaching Efficacy and Teaching Outcome Expectancy (Enoch & Riggs, 1990; Riggs & Enoch, 1990).

Evaluation Form 4: This evaluation form included items eliciting teachers' attitudes toward the information presented in the mini-conference and their perceptions of the presenters' skills in presentation of session information. Finally, two open-ended questions asked teachers to record their perceptions of the most effective activities of the follow-up session and to make suggestions to improve future follow-up sessions. This evaluation was conducted at the conclusion of the day. Additional clarification for all evaluation forms can be found in the final program evaluation report (Harwell, 1998).

Assessment Scoring and Analyses

All instruments were scored by this researcher and all data was entered into a statistical program, SYSTAT, which was used to calculate all statistical analyses (Wilkerson et al., 1992). Statistical probability was established at the .05 level of significance (Gay, 1996).

TEACHER BACKGROUND

Grade Level and Teaching Assignments

Table 1 compares the distribution of grade level assignments and percentage of teachers at each grade level who participated in the *Exploring Space: The Classroom Connection* follow-up mini-conference sessions. Of the 71 teachers who participated, the largest percentage (66.2%) constituted the combined groups of Pre-kindergarten through Elementary Level Grade 5. The Middle Level Grades 6-8 group comprised the second largest percentage (21.1%). Only three teachers (4.2%) were assigned to Secondary and/or College Level. A majority of these teachers (62%) reported responsibility for teaching all subject areas. Only seventeen percent (n = 12) reported teaching science more than three-fourths of the time. (See Table 2.)

Academic and Professional Background

Attendees of the *Exploring Space: The Classroom Connection* mini-conference sessions reported varying credentials in both their professional and academic preparation. Table 3 demonstrates that approximately 58 percent of these teachers possess a Masters Degree and/or a Masters Degree Plus Additional Coursework. Table 4 shows that the mean number of years of general teaching experience was 10.01 with a high of 28 years of experience and a low of one year, while the median number of years of general teaching was seven years. Mean scores for both math and science teaching experience showed similar variances, with a mean of 8.09 for math and 7.76 for science. Median scores for both math

and science were 5.00. The high standard deviation scores in all three categories of experience suggest a wide range of experience.

Table 1
Grade Level Assignments of Exploring Space Follow-up Attendees

Grade Level Taught	Number of Teachers	Percent of Teachers
Pre-Kindergarten - Grade 2	23	32.39
Comprehensive K - 6	1	1.41
Elementary Level 3 - 5	23	32.39
Middle Level 6 - 8	15	21.13
Secondary Level 9 - 12 and College	3	4.23
Gifted Program (several grades)	2	2.86
Media Specialist	1	1.41
Other	3	4.23

Note: Percentages may not total 100 due to rounding errors.

Table 2
Teaching Assignments for Exploring Space Follow-up Teachers
(N = 71)

Assignment	Number of Teachers	Percent of Teachers
All Subjects	44	61.97
Special Education	4	5.63
Math (more than 75%)	4	5.63
Science (more than 75%)	12	16.90
Gifted/School Enrichment	3	4.23
Other Subjects (Language Arts, etc.)	4	5.63

Note: Percentages may not total 100 due to rounding errors.

Table 3
Postsecondary Education Level of Program Participants

Degree	Number	Percent
Bachelor of Science	7	9.86
Bachelor of Science Plus Additional Coursework	22	30.99
Masters	15	21.13
Masters Plus Additional Coursework	26	36.62
No Response	1	1.41

Note: Percentages may not total 100 due to rounding errors.

Table 4
Years of Teaching Experience for Exploring Space Participants
(N = 71)

Experience Area	Mean	SD	Median	High	Low
General Teaching Experience	10.01	7.77	7.00	28	1.0
Science Teaching Experience	7.76	7.06	5.00	28	0.0
Math Teaching Experience	8.09	7.23	5.50	28	0.0

Table 5 displays the descriptive statistics regarding the number of methods and content courses for math and science completed prior to participation in *Exploring Space: The Classroom Connection*. Mean scores for math methods (3.43) and math content (4.53) indicate teachers have completed courses in alignment with certification requirements and Masters degree requirements. These participants have completed a larger mean number of science content courses (6.35).

Table 5
Number of Math and Science Methods and Content Courses Completed Prior to Program Participation
(N = 71)

Course Type	Mean	SD	Median
Math Methods	3.43	3.57	2.00
Math Content	4.53	4.19	3.00
Science Methods	3.55	4.33	2.50
Science Content	6.35	7.77	4.00

Ethnic and Gender Background of *Exploring Space: Classroom Connection* Participants

Table 6 reports that 90.1 percent (n = 64) of these participants were Caucasian. Only three teachers reported African-American heritage and one teacher reported Native American/Eskimo/Aleutian ethnic background. The majority of the teachers were female (84.4%). All 71 teachers responded to this query.

Table 6
Ethnic and Gender Background of Exploring Space Participants
(N = 71)

	Number	Percent
Ethnic Background		
Hispanic	0	0
Asian	0	0
African-American	3	4.23
Caucasian	64	90.14
Native American/Eskimo/Aleutian	1	1.41
Pacific Islander	0	0
Asian	0	0
Other	0	0
Gender		
Female	67	94.37
Male	4	5.63

Note: Percentages may not total 100 due to rounding errors.

Type of Schools Where Participants Teach

Table 7 indicates that 95.8 percent (n = 68) of the Alabama teachers who participated in the *Exploring Space: The Classroom Connection* follow-up mini-conferences taught in a public school. One teacher taught in a private school while two teachers taught in parochial schools.

School Location and Student Enrollment

The largest number of the teachers (n = 33; 46.5%) came from schools located in a rural setting while an equal portion of all teachers (n = 19; 26.8%) categorized their schools as suburban and/or urban. Clearly, the largest percentage of these Alabama teachers (50.7%) taught in schools with a student population in excess of 500 students. The second largest group taught in schools with a population between 300 and 499 students. (See Table 8.)

Student Population

Table 9 reports student population taught by *Exploring Space: The Classroom Connection* participants and breaks that population into six categories. Teachers were allowed to check multiple responses to more clearly portray their student population. These responses were collapsed to form the "Combination of Categories" category. The largest

category of responses constituted this group with 62 percent. The second largest group of students was represented by the minority group with 16.9 percent of the total responses.

Table 7
Type of Schools Where Exploring Space Participants Teach
(N = 71)

School Type	Number	Percent
Public	68	95.77
Private	1	1.41
Parochial	2	2.82
DoD/DoS Dependent School	0	0
Bureau of Indian affairs	0	0
Other	0	0

Note: Percentage may not total 100 due to rounding errors.

Table 8
School Location and Student Enrollment for Exploring Space Teachers
(N = 71)

	Number	Percent
Location		
Rural	33	46.48
Suburban	19	26.76
Urban	19	26.76
Student Enrollment		
0 - 99	0	0.00
100 - 299	6	8.45
300 - 499	27	38.03
500 +	36	50.70
Other (County-wide roving teacher)	2	2.82

Note: Percentages may not total 100 due to rounding errors.

Table 10 displays data regarding Alabama teachers' estimates of percentage of minority and female students they taught. The majority of teachers (n = 41; 57.8%) reported they taught fewer than 25 percent while the second largest group of teachers indicated they taught between 26 and 50 percent of minority students. A majority of the teachers estimated they taught between 26 and 50 percent female students. The second largest category comprised estimations between 51 and 76 percent.

Table 9
Student Population Taught by Exploring Space Participants

Category	Number	Percent
Honors/College Prep.	5	7.04
Minority	12	16.90
Special Education	2	2.82
Remedial	0	0.00
Combination of Categories	44	61.97
Other	7	9.86
No Response	1	1.41

Note: Percentages may not total 100 due to rounding errors. Total reflects multiple choices.

Table 10
Teachers' Estimates of Minority and Female Students Taught
(N = 71)

Category	N	Percent
Minority Students		
Fewer than 25%	41	57.75
26 - 50%	18	25.35
51 - 75%	1	1.41
76 - 100%	10	14.08
Female Students		
Fewer than 25%	3	4.23
26 - 50%	55	77.46
51 - 75%	13	18.31
76 - 100%	0	0.00

Note: Percentages may not total 100 due to rounding errors.

Personal Experience with Teaching Space Science

Most teachers reported a positive personal experience with teaching science. Mean scores above 3.0 were recorded on all items except two and indicated an agreement response with those items (Range of responses: Strongly Agree = 4 to Strongly Disagree = 1). Items showing mean scores less than 3.0 indicated some disagreement related to use of textbooks as an important part of the science program, and use of the inquiry approach to teaching to maximize computer technologies. Teachers did not perceive themselves prepared to use the inquiry approach to teaching science, although teachers reported textbooks were not an important part of their science program which is considered an important move in the direction of inquiry. Table 11 provides a summary of teachers' personal experiences with teaching space science.

[illegible]			
[illegible]			
1. I enjoyed teaching space science activities.	3.68	0.63	71
2. I integrated space science with other subject areas.	3.44	0.69	71
3. Textbooks were an important part of my science program.	2.21	0.91	71
4. I had access to enough space science materials to provide my students with hands-on experience.	3.13	0.89	71
5. Most students in my class would choose science as one of their favorite subjects.	3.35	0.66	71
6. I am willing to accept the "noise" that comes with an active, inquiry-based classroom.	3.47	0.69	71
7. I feel well-prepared to implement instruction reflective of current national standards in math.	3.07	0.8	71
8. I feel well-prepared to implement instruction reflective of current national standards in science.	3.17	0.74	71
9. I am well-prepared to use the inquiry approach to teaching to maximize computer technologies.	2.61	0.87	71
Range of Responses: Strongly Agree = 4; Agree = 3; Disagree = 2; Strongly Disagree = 1.			

Science Teaching Efficacy

The high item-sum score for Personal Science Teaching Efficacy Beliefs (Mean = 51.22) demonstrates that the Alabama teachers participating in the 1998 follow-up mini-conferences possess a strong belief that they have the skills and abilities to bring about student learning in science and this score reflects a strong sense of personal responsibility in student learning and behavior. (See Table 12.) These Alabama teachers are highly motivated. However, the second dimension of this instrument representing Teaching Outcome Expectancy shows that this group of teachers possess moderately strong beliefs that any teacher's ability to bring about change in student science learning is significantly limited by factors external to the teacher such as home environment, family background, and parental influences, lack of appropriate science equipment, etc.

Table 12
Science Teaching Efficacy Beliefs of Alabama Teachers in 1998 Follow-up Sessions
(N =65)

Efficacy Component	Mean	SD	Median
Personal Science Teaching Efficacy Belief (PTE)*	51.22	6.57	52.00
Science Teaching Outcome Expectancy Belief (TOE)**	43.97	4.46	43.00

*PTE Scale Range of Responses: Low = 13; High = 65.
**TOE Scale Range of Responses: Low = 12; High = 60.

Ways Participants Learned About *Exploring Space: The Classroom Connection*

The majority of Alabama teachers (n = 36; 50.7%) participating in these follow-up mini-conferences reported they learned about the summer program, *Exploring Space: The Classroom Connection,* through a former *Space Orientation for Professional Educators* participant (Table 13). The remaining participants discovered the *Exploring Space: The Classroom Connection* program through the flier/brochure that had been distributed during the previous academic school year and through a combination of categories.

Table 13
Ways Participants Learned About the Exploring Space Program
(N = 71)

Medium	Number	Percent
Flier/Brochure	25	35.21
Publication	0	0.00
NSTA ad	0	0.00
Former "SOPE" or "Classroom Connect" Participant	36	50.70
Other or Combination	10	14.08

Note: Percentages may not total 100 due to rounding errors.

ANALYSIS OF BASIC CONCEPTS OF SCIENCE

This section of the report examines teacher knowledge of basic concepts underlying inquiry-based science. The concepts identified are inherent in a process-based approach to science instruction intended to facilitate the development of problem-solving skills while encouraging independent thinking and learning among students. The notion that science is more than a collection of facts, concepts, and theories provides the basic premise of this approach. Science is a distinctive way of seeing and understanding the world. Therefore, exemplary instruction should provide students with extensive opportunities to learn and practice authentic scientific behaviors. These premises necessarily mean the introduction of manipulatives, instruments, and laboratory-type materials and activities into the curriculum and is suggestive of the constructivist epistemology and instructional practices in inquiry-based science. Instructional strategies appropriate for implementation of this type of curriculum include positive management strategies, performance assessments, assessment of prior knowledge, wait-time, asking for supportive evidence, non-judgmental teacher response, and student involvement in decision-making.

Table 14 presents a summary of the data by items and the concept average mean score and standard deviation from them mean in the shaded area of the table. Teacher responses ranged from Strongly Agree = 4 to strongly Disagree = 1. A *t* test for independent samples was calculated to determine if there was any significant differences in concept average mean scores for the 1996 group of teachers and the 1998 group of teachers.

Concept mean scores below 3.0 indicate areas where teachers could benefit from additional training and support. These concept areas include the constructivist approach, nature of science, and science standards. Although these three science concepts showed low overall average mean scores, the item mean scores within several other concept areas showed low mean scores. In fact, some concept areas in which high mean scores were reported showed a few items with low mean scores within that area. The *t* test showed no significant difference between the 1996 and 1998 Alabama teachers in all concept average mean scores with an exception of the category related to the nature of science which showed a significant difference at the .05 level of significance. (For additional information related to the 1996 follow-up of Alabama teachers, the reader should consult the final evaluation report prepared by Dr. Sharon Harwell entitled "Evaluation of Teacher Training Mini-Conference Sessions for 1996 Alabama Participants in SOPE Program," University of Alabama in Huntsville, March 24, 1997.)

Attitude Toward Science

Though not a specific content area, the five items that comprise this category reflect the philosophy and the basic premise of constructivism and the process-based science instruction. Even though 1998 teachers' average concept mean score of 3.32 and a range of item mean scores between 2.90 and 3.75 indicated an overall agreement with the philosophy, the item relating to science content over science processes showed some disagreement among teachers. The *t* test showed no significant difference between the 1996 group of Alabama teachers and teachers in the 1998 follow-up sessions.

The Constructivist Approach

Teachers demonstrated varied levels of understanding of this domain as reflected in the range of item mean scores: 1.78 - 3.03. The overall concept average mean of 2.42 indicated teachers have a somewhat confused understanding of the philosophy of constructivism and could benefit from additional instruction and support in this domain. Of special note is the low mean scores for the item related to student cooperative learning (1996 mean = 1.94; 1998 mean = 1.78). No significant difference between the two groups of Alabama teachers was found.

The Development of Concepts

Different teachers brought varying levels of prior knowledge to this concept area. Item mean scores for the 1998 teachers ranged from a low of 2.69 to a high of 3.21. The overall concept average of 2.97 demonstrated some agreement with the items included in this category. Concept average mean scores for both groups of teachers showed no significant difference when the *t* test for differences was calculated.

Inquiry in Science Education

Teachers in the 1998 follow-up sessions scored high in this concept domain with an overall concept average mean score of 3.29. Item mean scores ranged from a low of 3.11 to a high of 3.54 and teachers showed moderately strong agreement with the concept. Mean scores were almost identical for both the 1996 and 1998 Alabama teachers and the *t* test showed no significant difference.

Nature of Science

Teachers in the 1998 follow-up showed a mixed level of knowledge and understanding in this domain. Item mean scores ranged from a low of 2.24 to a high of 3.30 The overall concept mean score was 2.72 indicating that teachers tended to disagree somewhat with the items measuring this concept. The *t* test for differences between the two groups of Alabama teachers showed a significant difference in overall concept mean scores. Of special note is the low mean score for the item related to teaching the science concept of "microgravity." Alabama teachers could benefit from additional training and support in the are related to the nature of science.

Interdisciplinary Connections and Assessments

Alabama teachers in the 1998 follow-up sessions generally showed a moderate level of prior knowledge and understanding in this domain. Item mean scores ranged from a low of 2.85 to a high of 3.25 while the concept average mean score was calculated as 3.13 and is indicative of teacher agreement with the items representative of this concept. The *t* test showed no significant differences between the 1996 Alabama teachers and the 1998 group of teachers.

Attitude							
#1. Good science teaching emphasizes science content over science processes.	2.84	0.78	61	2.9	0.8	71	
#2. Good science teaching depends on good science textbooks.	3.06	0.72	67	3.28	0.66	71	
3. Students learn science best when they experience and conduct scientific investigations.	3.7	0.46	69	3.63	0.62	71	
4. Students learn science best when teachers relate the science lesson to everyday situations.	3.73	0.45	69	3.75	0.5	71	
#5. Having students learn science concepts is more important than their becoming independent investigators.	3.08	0.59	65	3.04	0.66	71	
Concept Average							
The Construction of Concepts	Mean	St	N	Mean	St	N	t value
6. Students' prior beliefs and knowledge are as important a factor in learning as the concepts being taught.	3.02	0.62	66	3.03	0.72	71	
#7. Teachers can transfer science knowledge by clearly presenting information to students.	2.21	0.73	66	2.3	0.71	71	
#8. A successful student adopts the mental representation of a science concept as presented by the teacher.	2.5	0.72	62	2.62	0.64	71	
9. Learning is made more difficult when a student has to work with other students who have different ideas/approaches.	1.94	0.68	65	1.78	0.74	71	
Concept Average							
The Development of Concepts	Mean	St	N	Mean	St	N	t value
#10. There is a specific set of teaching strategies that should be used by teachers to promote science learning.	2.85	0.69	65	2.69	0.79	71	
11. Assessing prior knowledge is a necessary first step in inquiry-based instruction.	3.12	0.59	68	3.2	0.62	71	
12. Communicating findings for others to understand is an important component of inquiry-based science.	3.21	0.51	63	3.21	0.58	71	
13. Students must quantify data to enable others to replicate their investigations.	3.02	0.72	53	2.79	0.61	71	
Concept Average							
Inquiry in Science Education	Mean	St	N	Mean	St	N	t value
14. A goal of science instruction is to encourage students to learn to conduct their own investigations.	3.55	0.5	66	3.54	0.73	71	
15. Students will learn more using data sheets that they developed than by using teacher-prepared data sheets.	3.11	0.73	66	3.11	0.73	71	
16. Students should begin participating in identification & control for variables in investigations as early as first grade.	3.37	0.49	60	3.25	0.73	71	
#17. Students who have been taught science using an inquiry-based approach will be weak in science content.	3.25	0.77	65	3.25	0.71	71	
Concept Average							

This negatively worded item has been recoded so a mean score approaching 4 reflects a correct response.
Range of Responses: Strongly Agree = 4; Agree = 3; Disagree = 2; Strongly Disagree = 1.
Note: Level of significance established at p<= .05.

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Table 10. Science Concepts of Alabama Teaching Force							
Natur...	Mean	SD	N	Mean	SD	N	t value
18. Children are involved in the nature of science when they are asking questions.	3.49	0.53	66	3.3	0.85	71	
#19. Effective science instruction depends on the teacher being able to answer most of the students' questions.	2.86	0.58	65	2.86	0.7	71	
#20. When teaching about microgravity, a good way to explain the concept is to say it is "weightlessness."	2.96	0.85	54	2.49	0.73	71	
#21. Most scientists follow the same sequence of steps in search of scientific knowledge.	2.25	0.72	56	2.24	0.75	71	
Concept Average							
Interdisciplinary Connections in Assessment	Mean	SD	N	Mean	SD	N	t value
#22. Science units designed to teach language arts, math, & social studies as well as science end up teaching students very little about science.	3.22	0.73	63	3.09	0.71	71	
23. Writing helps students clarify personal understanding of scientific concepts.	3.27	0.62	66	3.25	0.67	71	
24. Performance assessments can be used by teachers to promote learning as well as to assess student achievement.	3.26	0.44	66	3.24	0.55	71	
25. Providing students with scoring criteria and rubrics is an important part of effective science instruction.	2.84	0.73	57	2.85	0.61	71	
26. When students are responsible for deciding what to include in a portfolio, they are forced to examine their work from new perspectives.	3.3	0.53	64	3.23	0.61	71	
Concept Average							
Science Standards	Mean	SD	N	Mean	SD	N	t value
#27. We know that science learning has taken place when students can state important scientific facts.	2.69	0.72	62	2.79	0.61	71	
#28. Science subject matter standards specify the full range of what students in a particular local school should know and be able to do.	2.69	0.69	62	2.65	0.66	71	
29. Science subject matter standards identify a limited number of important concepts, principles, facts, laws, and theories that provide a foundation for understanding and applying science.	2.91	0.61	57	2.89	0.62	71	
30. Science standards define the level of understanding all students regardless of background, future aspirations, or interest in science, should develop.	2.75	0.8	59	2.65	0.8	71	
Concept Average							
# This negatively worded item has been recoded so a mean score approaching 4 reflects a correct response.							
Range of Responses: Strongly Agree = 4; Agree = 3; Disagree = 2; Strongly Disagree = 1.							
* $p < .05$ with 240 *df*							

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Science Standards

Many teachers, apparently, were aware of the science standards, but possessed a low level of prior knowledge on this domain. Item mean scores for the 1998 group of Alabama teachers ranged from a low of 2.65 to a high of 2.89 with an overall concept average mean score of 2.74. These scores were comparable to the 1996 group of teachers. No significant difference was found between the two groups of Alabama teachers when the *t* test was calculated. Overall, these scores indicate teachers need additional training and support in understanding and implementing the science standards.

TEACHER PERCEPTIONS OF CLASSROOM SCIENCE INQUIRY OPPORTUNITIES FOR STUDENTS

Table 15 presents Alabama teachers' perceptions of science class opportunities students have that provide experience in science inquiry. Teachers were asked to categorize items representative of exemplary science inquiry practice using the following rating scale: 1 = Student practice or experience in this area is on-going during the year; 2 = Students have practice or experience in this area, but only in the context of certain topics, lessons, or activities; 3 = Students have limited practice or experience in doing this; and 4 = Students do not do this in science class. A quick perusal of responses suggests that teachers believe some of their actions are supportive of good science learning and that there are also areas to target in order to increase science learning opportunities. In the 1998 group of Alabama teachers participating in the follow-up sessions, six teachers chose to give no responses. Four of the six teachers reported they taught math or art and it is reasonable to expect the remaining teachers might have taught a subject other than science and therefore chose not to respond.

A high frequency of Alabama teachers in the 1998 follow-up sessions reported "On-going classroom experience" in the following science inquiry activities: using scientific inquiry; interpreting data from graphs; making predictions; making observations; drawing inferences; using problem-solving strategies; using critical thinking; doing hands-on activities and experiments; and communicating results of their investigations to peers. Responses on several items suggested that many teachers were providing experience in science inquiry within the context of some of the topics, lessons and/or activities planned for students.

Of special note are several areas that should be targeted to increase science learning opportunities. Although small, a noticeable percentage (10% and above) of Alabama teachers reported they provided "no experience at all" in controlling variables, using laboratory equipment, analyzing science materials for validity of the information, designing and conducting their own activities and experiments, doing additional experiments if discrepancies exist between answers and explanations, keeping a laboratory log or journal, and reading and discussing the work of scientists. Specific numbers and percentages for each item can be obtained from the final evaluation report (Harwell, 1998).

Table 15
Teachers' Perceptions of Science Class Opportunities Students Have That Provide Experience in Science Inquiry

Students have practice doing the following: * Item	On-going Experience		Lesson Context Only		Limited Practice		Do Not Do This		No Response	
	n	%	n	%	n	%	n	%	n	%
1. using scientific inquiry	**30**	42.3	**20**	28.2	**12**	17.9	**3**	4.2	**6**	8.5
2. posing researchable questions followed with an opportunity to investigate their own questions	**20**	28.2	**20**	28.2	**19**	26.8	**6**	8.5	**6**	8.5
3. developing science hypotheses	**19**	26.8	**24**	33.8	**15**	21.1	**7**	9.9	**6**	8.5
4. testing hypotheses	**20**	28.2	**21**	29.6	**19**	26.8	**5**	7.0	**6**	8.5
5. controlling variables	**16**	22.5	**22**	31.0	**17**	23.9	**10**	14.1	**6**	8.5
6. collecting data	**27**	38.0	**24**	33.8	**7**	9.9	**7**	9.9	**6**	8.5
7. graphing data	**27**	38.0	**21**	29.6	**10**	14.1	**6**	8.5	**6**	8.5
8. interpreting data from graphs	**36**	50.7	**15**	21.1	**7**	9.9	**7**	9.9	**6**	8.5
9. using laboratory equipment	**15**	21.1	**21**	29.6	**20**	28.2	**9**	12.7	**6**	8.5
10. making predictions	**52**	73.2	**4**	5.6	**5**	7.0	**4**	5.6	**6**	8.5
11. making observations	**51**	71.8	**6**	8.5	**4**	5.6	**4**	5.6	**6**	8.5
12. drawing inferences	**45**	63.5	**12**	16.9	**3**	4.2	**5**	7.0	**6**	8.5

Table 15 (cont'd)
Teachers' Perceptions of Science Class Opportunities Students Have That Provide Experience in Science Inquiry

Students have practice doing the following: * Item	On-going Experience		Lesson Context Only		Limited Practice		Do Not Do This		No Response	
	n	%	n	%	n	%	n	%	n	%
13. analyzing science materials for validity of the information	11	15.9	25	35.2	19	26.8	10	14.1	6	8.5
14. using multiple science resources	26	36.6	24	33.8	11	15.5	4	5.6	6	8.5
15. using problem-solving strategies	41	57.8	14	19.7	5	7.0	5	7.0	6	8.5
16. using critical thinking	44	62.0	9	12.7	7	9.9	5	7.0	6	8.5
17. doing hands-on activities and experiments	39	54.9	51	21.1	6	8.5	5	7.0	6	8.5
18. designing and conducting their own activities and experiments	7	9.9	18	25.4	32	45.1	8	11.3	6	8.5
19. repeating experiments more than once to collect data analysis	9	12.7	23	32.4	28	39.4	5	7.0	6	8.5
20. doing additional experiments if discrepancies exist between answers and explanations	7	9.9	24	33.8	26	36.6	8	11.3	6	8.5
21. keeping a laboratory log or journal	23	32.4	14	19.7	18	25.4	10	14.1	6	8.5
22. conducting extended investigations in science	12	16.9	18	25.4	28	39.4	7	9.9	6	8.5
23. communicating the results of their investigations to peers	29	40.9	19	26.8	13	18.3	4	5.6	6	8.5
24. working like scientists in conducting science inquiry	17	23.9	28	39.4	18	25.4	2	2.8	6	8.5
25. reading and discussing the work of scientists	9	12.7	22	31.0	24	33.8	10	14.1	6	8.5

* Adapted and used by permission of Dr. Sandra K. Enger, Institute for Science Education, University Of Alabama in Huntsville

TEACHERS' PERCEPTIONS OF THEIR SCIENCE CLASSROOMS

Table 16 presents teachers' perceptions of their science classrooms. Generally, as a group these Alabama teachers report that students often work in groups or teams, and especially so when doing science activities, making predictions about what will happen before they do activities or experiments, making observations when they do activities, writing down their observations from an experiments, and if activities or experiments do not appear to work as predicted, they discuss reasons why. On the other hand, results indicate that students seldom work alone when doing science activities and seldom design their own experiments or try experiments that they design themselves. These teachers also reported that students seldom set up their own experiments and seldom read about the research work that scientists do and seldom go on field trips off-campus that relate to what they do in science class. As a rule, mean responses for this group of Alabama teachers indicated that students sometimes engaged in the selected science activities included in this survey instrument.

TEACHERS' PERCEPTIONS OF WHO MAKES DECISIONS ABOUT SCIENCE LESSONS AND ACTIVITIES

In this group of Alabama teachers, responses to the question "Who decides what science lessons and activities are done in science class?" indicate that teachers decide what the science lessons are about and also teachers decide what science activities and experiments students do. (See Table 17.) This finding corresponds to teachers' responses concerning their perceptions that students seldom set up their own experiments and seldom design their own experiments or try experiments on their own. This finding most certainly points to a teacher-driven classroom learning environment when compared to a learner-centered environment.

SATISFACTION WITH *EXPLORING SPACE: THE CLASSROOM CONNECTION* FOLLOW-UP CONTENT AND PRESENTATION

Teachers participating in the 1998 follow-up sessions rated their satisfaction with the various content mini-sessions by rating them on various aspects: helpfulness, application of ideas presented, new information, appropriateness and usefulness of selected materials, clarity of presentation, trainers being well-informed and engaging, confidence in using the inquiry approach, ability to implement science and math standards, and attainment of a more meaningful understanding of integration of the world wide web into the science classroom. Mean scores for each aspect are presented in Table 18. All items were positively phrased so '4' or 'Strongly Agree' represents the greatest satisfaction and '1' or 'Strongly Disagree' represents the least satisfaction with any aspect of all sessions.

Item mean scores ranged from a low of 3.38 to a high of 3.81 and scores were indicative of overall high ratings, although some items were rated higher than others. From the results in Table 18, one can see that teachers were satisfied with all aspects of the follow-up sessions. Teacher ratings for "trainers being well-informed" and "gaining new information" received the highest rating (Mean = 3.81), while items related to confidence in ability to implement instruction reflective of current national standards in math (Mean = 3.38) and science (Mean = 3.40) and use of the inquiry approach to teaching (Mean = 3.46) were among the lowest rated aspects of the follow-up sessions.

Table 16
Teachers' Perceptions of Their Science Classroom*
(N = 71)

In your science classes, how often do your students do the following?

Item	Mean	SD
1. work in groups or teams	4.15	.95
2. work in groups or teams when they do science activities	4.30	.93
3. work alone	2.80	.75
4. do activities and experiments in science class	3.91	.94
5. work alone when they do science activities and experiments	1.99	.77
6. design their own activities and experiments	2.71	.87
7. try activities or experiments that they design themselves	2.71	.89
8. test a hypothesis or question in their activities or experiments	3.49	.98
9. control variables when they do lab activities or experiments	3.23	.96
10. ask questions and then investigate their own questions	3.56	.96
11. make predictions about what will happen before they do activities or experiments	4.09	1.15
12. set up a data table when they do activities or experiments	3.42	1.19
13. make observations when they do activities or experiments	4.17	1.03
14. write down their observations from an experiment	4.00	1.02
15. write about the experiments that they do in a notebook, log, or journal	3.65	1.17
16. write down their own information from a science experiment	3.53	1.04
17. graph numbers from their experiments	3.29	1.04
18. discuss the results from their experiments	4.08	1.07
19. set up their own experiments or activities	2.94	.94
20. try experiments more than one time to check their results	3.42	.98
21. read about the research work that scientists do	2.85	1.06
22. discuss the research work that scientists do	3.08	.93
23. discuss science articles from newspapers or magazines	3.33	.95

Rating Scale: 5 = Very Often; 4 = Often; 3 = Sometimes; 2 = Seldom; 1 = Never

Table 16 (cont'd)
Teachers' Perceptions of Their Science Classroom*
(N = 71)

In your science classes, how often do your students do the following?

Item	Mean	SD
24. go to the school library or media center to find science information	3.46	1.00
25. watch and then discuss science videos	3.52	.98
26. have the opportunity for science visitors to come to the class to talk about science	3.05	1.06
27. go on field trips on-campus (school ground)	3.09	.97
28. go on field trips off-campus that relate to what they do in science class	2.89	.96
29. watch the teacher doing experiments for the class	3.26	1.03
30. If activities or experiments do not appear to work as predicted, they discuss reasons why	4.05	.92

Rating Scale: 5 = Very Often; 4 = Often; 3 = Sometimes; 2 = Seldom; 1 = Never

* Adapted and used by permission of Dr. Sandra K. Enger, Institute for Science Education, University of Alabama in Huntsville

Table 17
Teachers' Perceptions of Who Makes Decisions About Science Lessons and Activities

Who decides what science lessons and activities are done in science class?*

Item	Mean	SD	Responses
1. The teacher decides what the science lessons are about.	3.85	.98	66
2. The students in the class decide what the science lessons are about.	2.65	.94	66
3. The teacher decides what science activities and experiments the students do.	3.77	1.02	66
4. The students in the class decide what science activities and experiments are done.	2.61	.86	66

Range of Responses: Very Often = 5; Often = 4; Sometimes = 3; Seldom = 2; Never = 1.

* Adapted and used by permission of Dr. Sandra K. Enger, Institute for Science Education, University of Alabama in Huntsville.

Table 18 Satisfaction with follow-up Content and Presentation

Aspect of Satisfaction	Mean	SD	Responses
1. Information presented during these follow-up sessions was helpful to me.	3.75	0.62	63
2. I can apply most of the ideas presented in my classroom.	3.56	0.73	64
3. I gained new information during these follow-up sessions.	3.81	0.5	64
4. Session materials were appropriately selected.	3.73	0.55	63
5. Information in the follow-up sessions today was presented clearly.	3.77	0.53	64
6. The session facilitators were well informed and demonstrated knowledge of the subject matter.	3.81	0.53	64
7. The session facilitators were engaging and communicated material clearly and in an interesting manner.	3.75	0.56	64
8. I am more confident about using the inquiry approach to teaching.	3.46	0.67	63
9. Resources utilized were appropriate and will be useful to my students and school.	3.59	0.66	64
10. I am more confident in my ability to implement instruction reflective of current national standards in science.	3.4	0.66	63
11. I am more confident in my ability to implement instruction reflective of current national standards in math.	3.38	0.71	63
12. I have a more meaningful understanding of how to integrate use of the world wide web (www) in my classroom.	3.64	0.6	63
Range of Responses: Strongly Agree=4; Agree=3; Disagree=2; Strongly Disagree=1			

TEACHERS' WRITTEN RESPONSES

Teachers were asked to tell us about the most effective activities during the follow-up sessions and to share their suggestions to improve future follow-up sessions. Teachers were generally very pleased with all the sessions and activities they engaged in during the mini-conferences and with presenters' enthusiasm, preparation, and willingness to accept *Exploring Space: The Classroom Connection* participants' ideas, questions, and comments. On the other hand, teachers made suggestions for improvement that were incorporated by project personnel throughout subsequent mini-conferences.

A full account of all participant responses can be found in the final technical report (Harwell, 1998). Only representative responses from Alabama teachers regarding the most effective activities and suggested improvements are included in this discussion. The internet work session and the relaxed sharing time seemed to be very effective. Teachers especially liked the **sharing time**. The following quote is a typical response: "I got to hear and see how other teachers had implemented all the information." Another teacher wrote: "It was of great help to meet once again with fellow educators to see how they are implementing SPACE into their classrooms." Many teachers reported they planned to "use the www sites immediately upon return to their classroom." The "tessellation" activity was a big "hit," fun, and interesting. One teacher commented: "This follow-up was great!" while another wrote "this was the best follow-up sessions I have attended." Several responses related to the usefulness of the *Human Physiology in Space* resource book and the *Mission Mathematics* guides for each grade level. Overall teachers thought "the program was well-planned, the facilities were excellent," and instructors were "great and very personable."

Teachers suggested more follow-up sessions and that sessions be planned for a longer period of time, possibly for two days. Several suggestions were made to "lessen 'gap' time between sessions" and "pack more into designated time limits!" Others suggested that during sharing time, teachers should be placed in small groups according to grade levels. Some suggestions were made to incorporate sessions related to astronomy, geometry, and estimation. Requests for more time to work on the internet and to plan 'more time for us to share" were made. In spite of these suggestions regarding the sharing time, overall teacher responses were positive and teachers believed the sharing session "motivated" teachers for "another year," and "provided new ideas" for teachers to carry back to their classroom.

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